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CIRCULARITY IN PLASTICS IN SOUTH AFRICA

Cascading plastic packaging for maximum circularity

A circular economy for plastics has projected net economic and job creation benefits in both developed and developing country settings. South Africa has good potential to realise the benefits in a circular economy for plastics, building on expertise in both the plastics production and recycling sectors. This series of 10 briefs provides the context of the plastics industry in South Africa and highlights opportunities in a circular economy: Part 4 of 10

Maximum circularity of plastics can be enabled by maintaining products and materials at maximum material quality at the end their useful life. This necessitates a definition of the 'quality' of the circular intervention to promote maximum circularity in plastics, whether it be elimination or avoidance of products or plastics that cannot be circulated, reuse of the product, closed-loop recycling, or open-loop recycling. The focus of this brief is on one of these types of circular interventions, namely **recycling**.

The concept of a "cascade diagram" provides a practical tool to give guidance on how to maintain maximum material quality during recycling and thereby maximise the potential for circular use of packaging plastics.

Such diagrams may be useful in demonstrating the impacts of design choice on circularity to brand owner- and retailer marketing staff, as well as packaging technologists, who often do not have insight into how the packaging will fare in the recycling stream (**Figure 1**). Material cascading is context specific due to, among others, the type and nature of recycling processes in place. The diagrams presented in this brief are the recommended material cascades for plastic packaging by polymer in the South African context.[1]

In the material cascade diagrams, the y-axis represents the range of applications that a certain packaging input to the South African recycling system can be recycled into. The diagrams are structured such that the packaging type at the top left of the diagrams can be recycled into the most number of other packaging applications, and therefore is considered the 'most circular' packaging choice for that polymer-product combination.

[1] Note that these have been developed in relation to material quality and do not represent recommendations based on a full life cycle assessment (LCA) of options.

Closed-loop recycling, where plastic packaging is recycled into the same or a similar format to that which entered the recycling stream, maintaining plastics at their maximum value for circularity.

Open-loop, mono-polymer recycling, where plastic packaging is recycled into another product (not primary plastic packaging) likely for use in another sector as open-loop recycling, but is maintained as a mono-polymer product. There is lost utility of this product at end-of-life, as it can be recycled into fewer applications than if it had been included in a closed-loop recycling process.

Open loop, compatible multi-polymer recycling, where the packaging is recycled with compatible polymers (such as HDPE with LDPE). There is lost utility in the resulting material as it is only suitable for a limited number of applications, but there is still sufficient value in that product at end-of-life that it may be recycled into another product.

Open loop, incompatible multi-polymer recycling, where the plastic packaging is added to polymers incompatible for producing material for a range of products, and recycled into applications which have a very wide material specification, and accommodate a mix of polymers often in undefined proportions. The resulting products have low value at end-of-life and are therefore, generally, not recovered for recycling.

Open-loop, mixed material recycling where plastic packaging material is mixed with other materials like sand, and cement, or paper fibre to make hybrid products. The mixing of material types means that products at end-of-life can only be returned to the same manufacturing process for recycling (if at all). Collection systems for such products are generally not in place, and are unlikely to be instituted. The best place for such products at end-of-life is likely landfill. These products may 'immobilise' the plastic for a decade or two (in some cases these products leak plastics directly into the environment), but in the timescale of plastic persistence, this is a temporary 'solution'. This is not a recommended circular intervention.

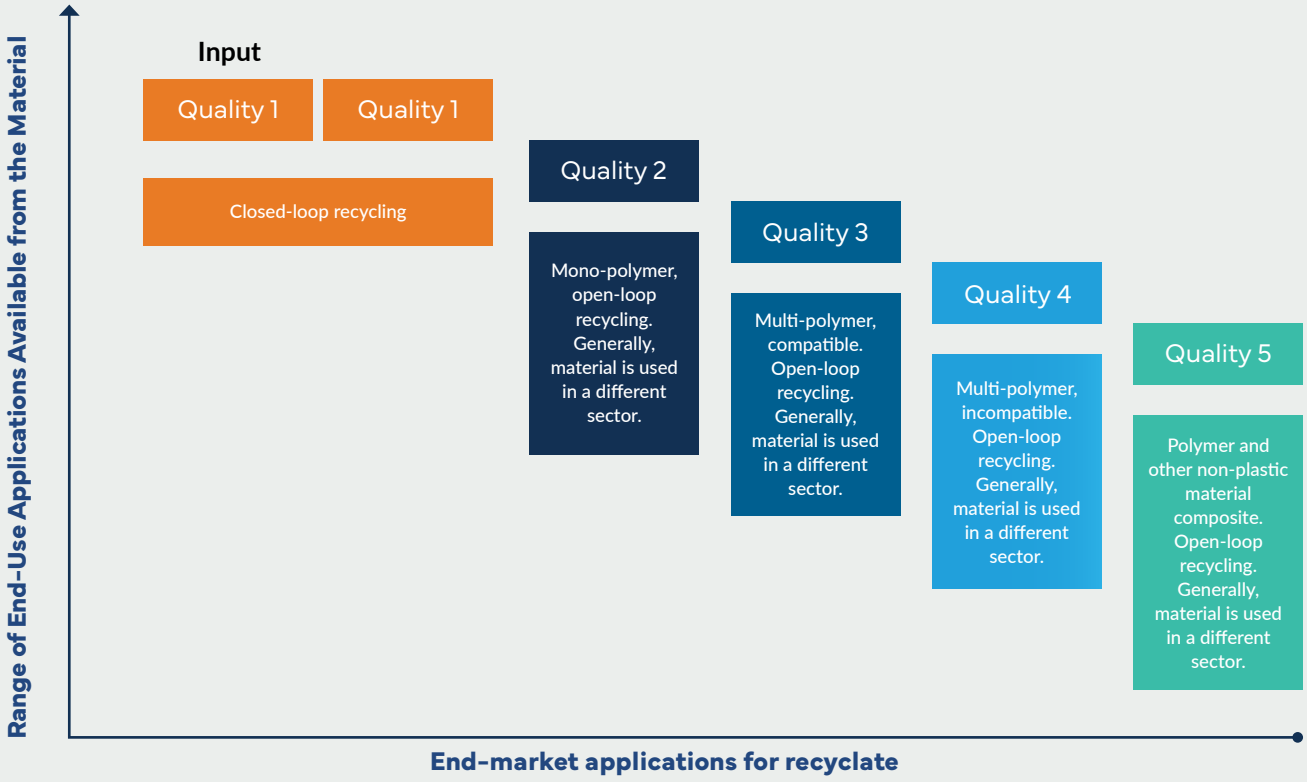

Figure 1: Generic representation of a material cascade that can be used to represent possible applications for packaging formats by polymer, and the implications for the value of the material at end of life for each product made from the recycled material

PET packaging material cascades are presented in the figures below as examples of material cascades to communicate best choices in PET packaging for circularity.

Along the x-axis, from left to right, the general packaging types for each polymer group are presented (input into recycling system), followed by packaging formats (output – packaging) that packaging entering the recycling system can be recycled into, and then applications for recyclate from the input packaging formats in other sectors (output – other sector). The most circular material flows from input to output applications, maintaining the packaging material at the highest value, are represented in **green**, while material flows that lead to decreased material value are depicted in **dark blue**. The **light blue** arrows represent likely new material flows in the South African context in 2022.

Input plastic packaging types are in **dark blue** boxes, with packaging including recycling content in **light blue**, and non-packaging in orange. Applications that are most likely not to be recycled at end of life are in **maroon** boxes.

Note: only material flows from between input and the first application of recycled content are noted, as well as where the "output" products can be recycled into the same product. Material flows to another application from the "output" products in the diagram can be assumed to follow the same pathways, as the flows depicted from the packaging "input" to the product "outputs" whether in packaging or in another sector.

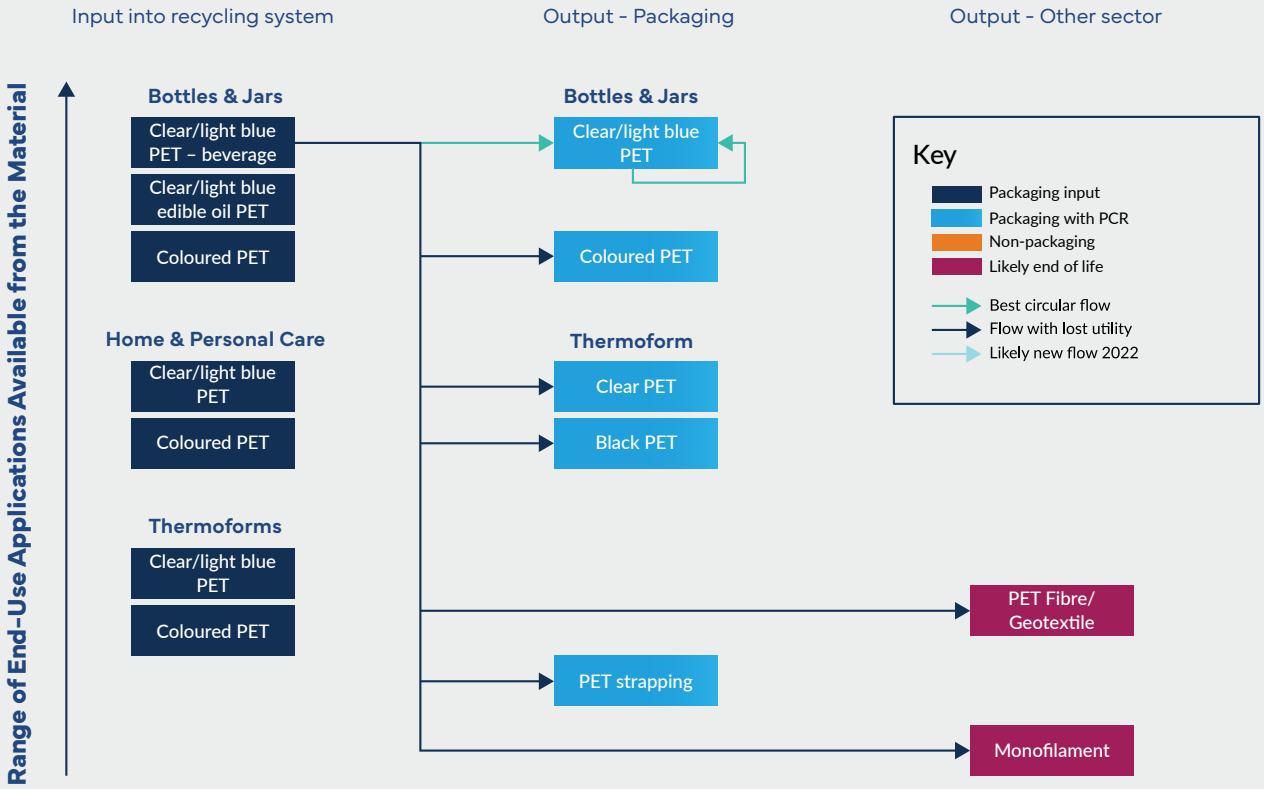

Figure 2: PET packaging cascade across a range of recycled content end-use applications – clear bottles (beverage)

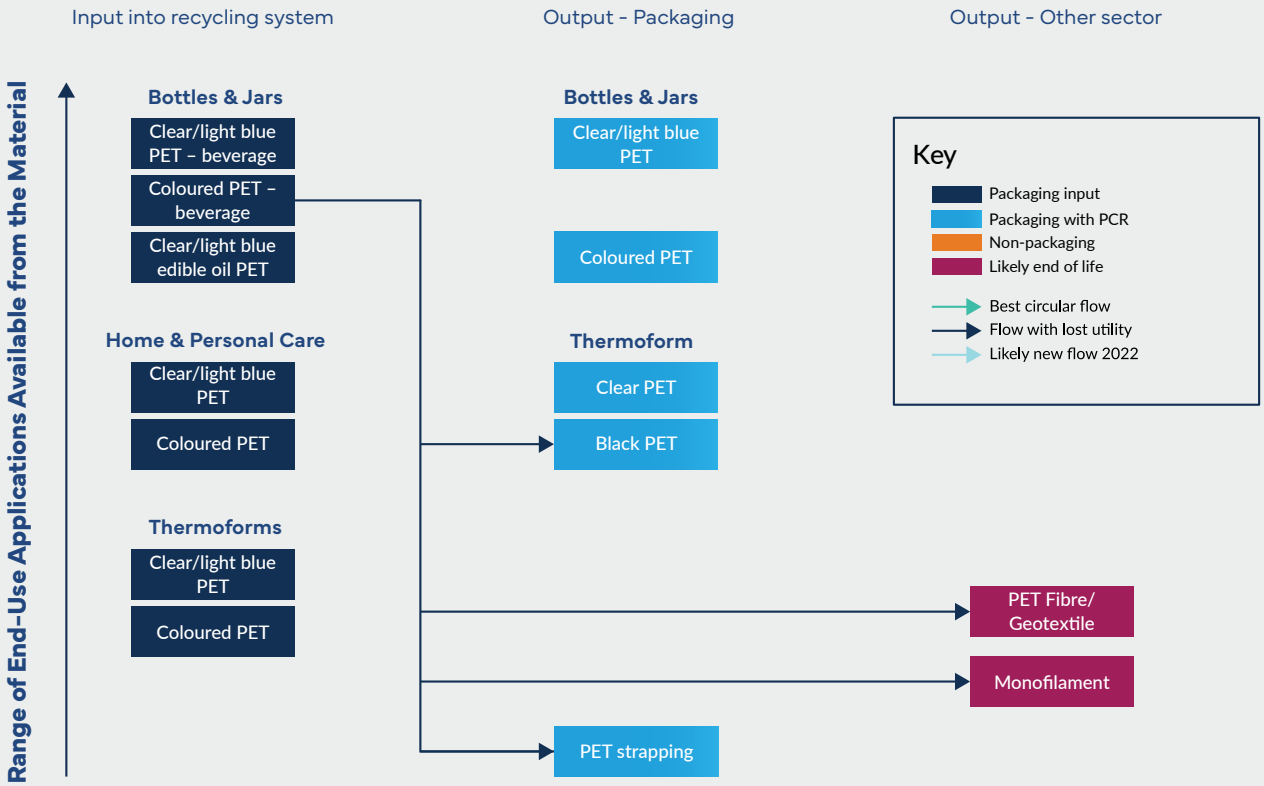

Figure 3: PET packaging cascade across a range of recycled content end-use applications – coloured PET beverage

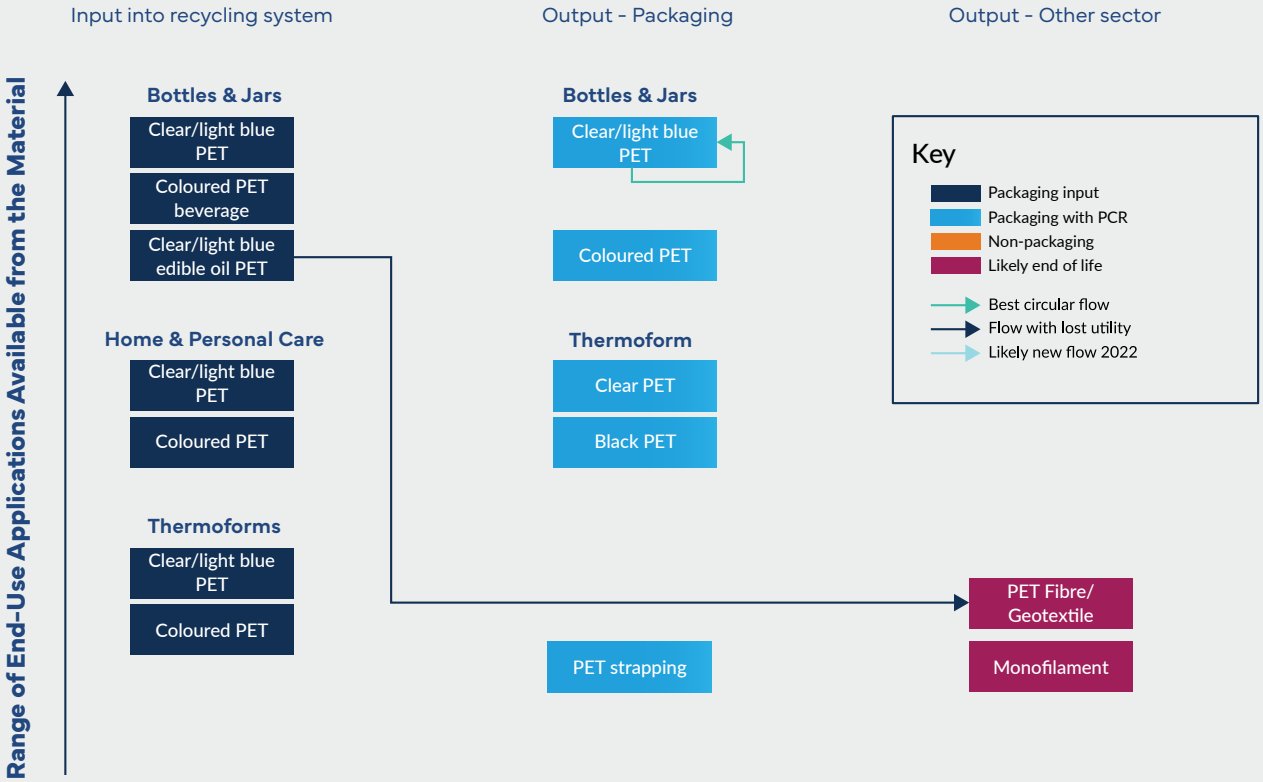

Figure 4: PET packaging cascade across a range of recycled content end-use applications – clear / light blue edible oil bottles

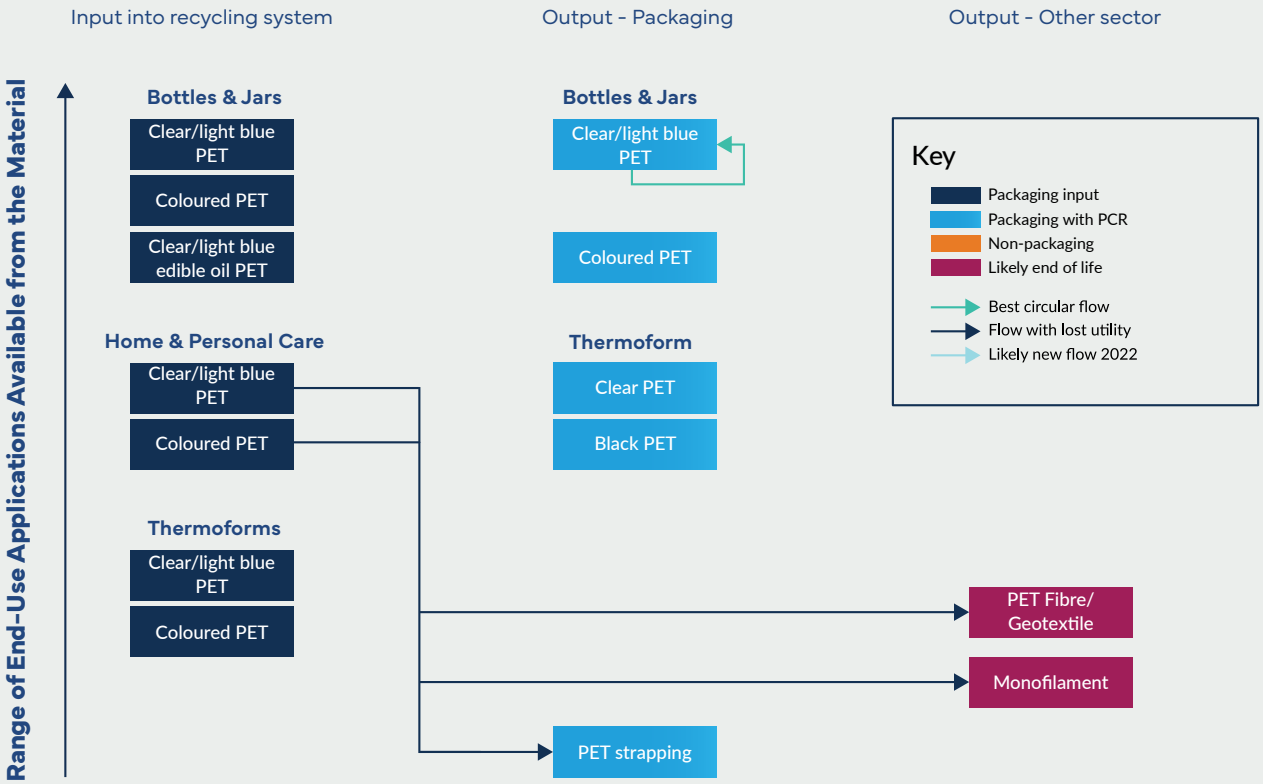

Figure 5: PET packaging cascade across a range of recycled content end-use applications – home & personal care

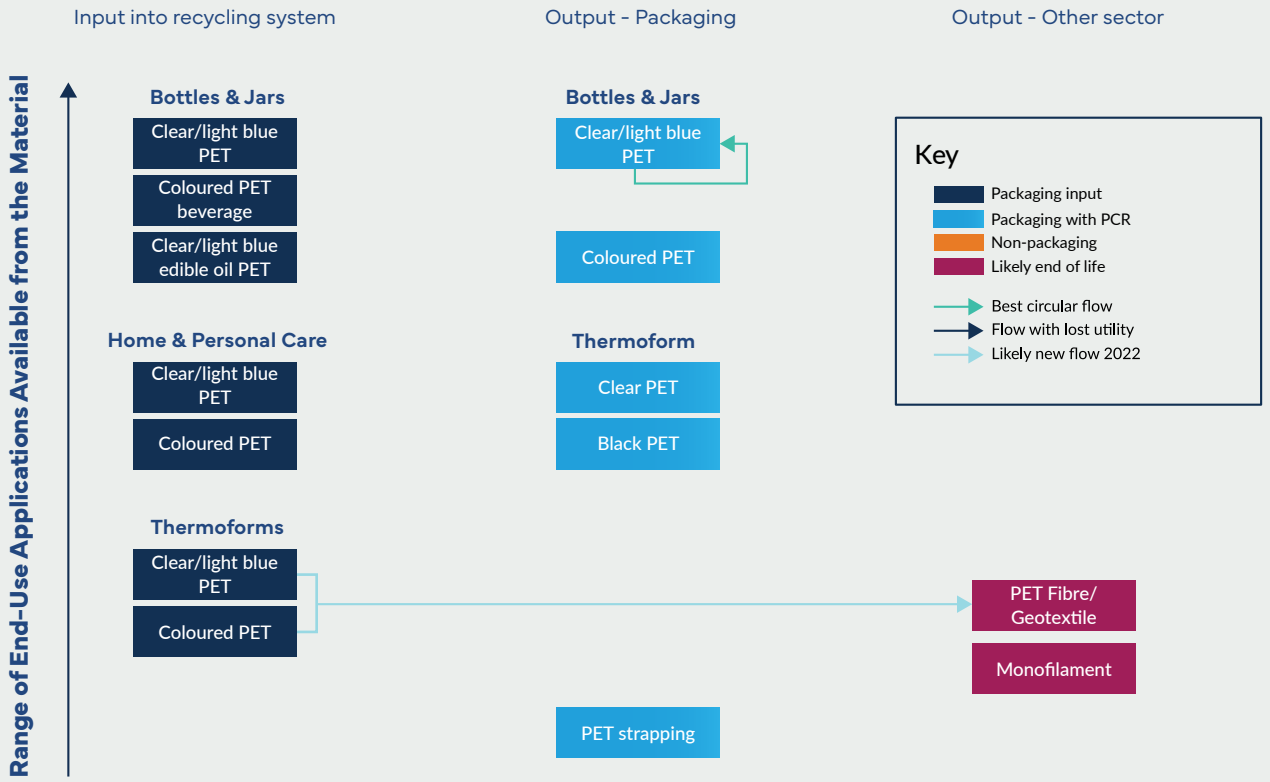

Figure 6: PET packaging cascade across a range of recycled content end-use applications – thermoforms

Further development of such cascades for other polymer types used in plastic packaging are planned by the **SA Plastics Pact** to support designing for circularity in plastic packaging in South Africa.

This summary is an extract from the report "*Market assessment of circular plastics opportunities in packaging, construction, agriculture and the automotive industry*", which forms part of a series "*Circularity in the plastics value chain in South Africa – opportunities and barriers*". The reports in the series are:

- **Part 1:** The Plastics Landscape in South Africa – Mapping value chains and key players.
- **Part 2:** South African enabling environment for a circular economy for plastics – a scan of best practice and current local and international policies and legislation.
- **Part 3:** Market assessment of circular plastics opportunities in packaging, construction, agriculture and the automotive industry.
- **Part 4:** A focus on increasing recycled content in packaging through multi-layer conversion.
- **Part 5:** Advanced recycling technologies in South Africa – status quo and potential.
- **Part 6:** Alternatives to problematic plastic packaging in South Africa.
- **Part 7:** The current state of waste plastics management in South Africa.
- **Part 8:** Realising opportunities for a circular economy for plastics in South Africa: actions for the short, medium- and long-term.

The individual reports and a summary of the entire series can be accessed by contacting the GreenCape Circular Economy team via **circulareconomy@greencape.co.za**.

The series is a product of the staff of the World Bank in collaboration with a research and analysis team comprising of GreenCape, the African Circular Economy Network (ACEN) Foundation, the South African Plastics Recyclers' Organisation (SAPRO), WRAP, and WWF South Africa. Financing for this work comes from the **PROBLUE Trust Fund**.

The SA Plastics Pact | GreenCape